SCIENCE

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THE UPPER STRATA OF THE ATMOSPHERE.

AT a meeting of the Geographical Society of Berlin on May 2, 1891, Professor Förster read a paper on "The Upper Strata of the Atmosphere," a report of which is given in the Proceedings of the Royal Geographical Society for July. Professor Förster began by saying that the earlier conceptions of the height of the earth's atmosphere were based mainly upon observations as to the duration of the twilight, and as to the extent to which the light of the heavenly bodies was refracted. On the basis of such observations, the height of the atmosphere was estimated at from forty to fifty miles; it was not, however, by any means thought that, above these altitudes, there were no other strata belonging to the earth, but only that the density of the latter was too small for them to produce the optical effects just specified. The discovery of a means of determining the existence of such extremely thin strata beyond a height of fifty miles dates from the end of the eighteenth century, when attempts were first made to measure, according to Chladni's principles, the heights at which the first illumination of falling stars takes place.

A specially comprehensive investigation with reference to these heights was carried out at the instance of the Berlin Observatory in August, 1867, by means of simultaneous observations in the neighborhood of Berlin, with the result that not one of the altitudes at which illumination commences, and which were measured with sufficient accuracy, was found to exceed practically a hundred miles. These results, however, possess only a relative value, being valid only for the falling stars of the month of August, the so-called Perseides; for it is evident that illumination will arise earlier or later, and at different altitudes, according to the varying velocities with which the small heavenly bodies penetrate the atmosphere. Illumination will take place earliest in the case of those falling stars which move in a directly opposite direction to the movement of the earth, which travels at about nineteen miles per second. These heavenly bodies, possessing a velocity of their own of about twenty-six miles per second, consequently enter the earth's atmosphere with a velocity of forty-five miles; while in the case of those bodies which tend to be overtaken by the earth in their movement round the sun, the velocity can, in the most extreme case, only be equal to the difference between the two velocities above-mentioned, viz., seven miles.

The altitudes at which extinction, that is to say, the almost complete dissolution of these heavenly bodies, commences, vary very much, because the rapidity of the extinction is dependent upon the size and composition of the bodies themselves. The Berlin observations of 1867 gave for this an average height of about fifty miles. From these observations as to falling stars it is also supposed that the boundary between the strata which participate in the earth's movement and those which resist it should be fixed at least at some miles higher than a hundred miles. It is here also that the bodies become heated prior to their illumination.

The polar lights extend to still greater altitudes; their height, at the time of their greatest development, when they are visible as far as the tropics, would be from 300 to 375 miles, while in the polar regions they spread themselves, as a rule, at a height of only a few miles, indeed quite close to the earth's surface. But there remains the question whether at those altitudes there are still strata which follow the movement of the earth round the sun; for it is possible that the phenomena of the electric glow, which the polar lights may be considered to be, radiate from the earth into the heavens, follow also the earth's movement round the sun, but at the same time extend beyond the strata belonging to the earth into the strata of extremely rarefied gases, which in all probability fill up the space between the planets and the sun. This space may be designated as the "Himmelsluft," and is not to be confounded with the so-called "ideal medium," viz., ether, in which luminous phenomena are supposed to occur.

Evidence in support of the existence of such a "Himmelsluft" is to be found in the conditions existing on the sun, which are gradually becoming more completely known. On the sun, gases are continually being developed and given off as the result of explosive processes as well as of the dissolution and volatilization of the numerous small meteoric bodies which are incessantly hastening to the sun. Further, the movement of Encke's comet, which, in its return, occurring in periods of twelve hundred days, remains longest in the vicinity of the sun, has furnished important evidence of the obstructive effect of a so-called "Himmelsluft." The movements of other comets and of the planets have not yet afforded evidence of such an influence, but it must be borne in mind that the perceptibility of such an effect depends not only on the density, which increases towards the sun, but also on the proportion which the surface of the heavenly body in question bears to its mass. This proportion is very much greater in the case of comets than in the case of planets, and may also in one comet be much greater under certain conditions than in others.

Indications of the counter-influence of the relatively quiet "Himmelsluft" as compared with the earth, which rushes through it with a velocity of about nineteen miles per second, can be recognized in the highest strata in the case of the movements of the luminous tails and clouds of light which many falling stars and fireballs leave behind them along their flying course, that is, when these remain visible for some minutes. The changes of position and form, which proceed apparently very slowly in these luminous forms, due regard being paid to their great height and distance from the observer, are supposed to be executed with a velocity of more than sixty yards a second. The movements which take place in these meteoric tails are, according to all appearances, not so simple that they can be explained merely as being the result of the highest strata being left behind in consequence of the velocity with which the observer on the earth's surface is being whirled along, and which at the equator amounts to seventeen miles a minute, and at our latitudes to about eleven miles a minute. The very considerable alterations of form which these tails undergo in shift-

ing their position, point to very complicated conditions of movement. But the counter-influence of "Himmelsluft," as compared with the movement of the earth round the sun, is a necessary consequence, not only of the movements in the highest strata of the atmosphere, but also of the effects of pressure, which could not remain unnoticed in the case of very delicate barometrical measurements. If the daily period of fluctuation of the atmospheric pressure were not influenced by so many different factors, — for example, by the daily warm period and, theoretically at least, by a certain operation of ebb and flow caused by the sun and the moon through their powers of attraction in the atmosphere as well as in the ocean, and perhaps also by the electrical conditions of the atmosphere, — there must be, at that time of day at which a given station arrives, in consequence of the earth's rotation, on the front side of the mighty "vessel" which transports us round the sun with a velocity of nineteen miles a second, a somewhat greater atmospheric pressure. This time of day is, as a rule, between midnight and midday.

In the polar regions the state of affairs is a little more complicated. In these zones an observer can, during the winter, for a longer or shorter period, according to the geographical latitudes, remain on the front side of the earth, while in summer he finds himself turned over on to the back of the earth, viz., on that side which is away from the direction of movement. In lower latitudes the mercury in the barometer must always stand higher during the morning hours than during the rest of the day. In consequence of the collective effect of the various factors which influence the daily period of the pressure of the atmosphere, the result is a very complicated one.

Within the last five or six years a group of phenomena has arisen, which is of the greatest importance in considering the problem of the conditions in the upper strata of the atmosphere. The last of the series of phenomena connected with the Krakatoa eruption are the so-called luminous clouds, which have since that time been observed during the night in the summer months on both hemispheres at a height of about fifty miles. These clouds consist obviously of the smallest molecules of water, which have been projected to their highest point, and which during the summer nights have reflected down upon us from that great height the direct rays of the sun. The long duration of this phenomenon makes it a very remarkable one. During the last two years, for which very accurate photographic determinations of altitude are available, the average height of these clouds has not altered. This can only be explained if we suppose the existence in those altitudes of an opposing force, which nearly overcomes the influence of gravity, in consequence of the giving off of electricity.

In the last few years not only has the density of this collection of matter been very materially lessened, but its geographical and periodical distribution over the different regions of the globe has become more restricted and regular. In Germany these clouds have, during the last three years, only been seen between the end of May and the end of July, towards the north, at a distance of from 310 to 435 miles; on the southern hemisphere, at the southern extremity of America, only during the local summer (December), and then towards the south. It may, therefore, be supposed that this collection of the smallest molecules travels every year from one polar zone of the earth to the other, so that it is found just over that hemisphere where summer is at its height. This periodical movement would be completely unintelligible if the counter-influence of the "Himmelsluft" on those high strata of the atmosphere which participate more or less entirely in the rotation of the earth on its axis and round the sun, did not furnish an explanation. In consequence of the inclined position of the earth's axis, and of the counter-effect of the "Himmelsluft," there occurs from June to December a disposition, reaching its maximum in September, on the part of those strata, to travel from the northern to the southern hemisphere; while from December to June the reverse is the case. It is calculated that for such a periodical journey from pole to pole an average velocity in the north and south direction, or *vice versa*, of only little more than a yard a minute is necessary, a rate which is quite insignificant when compared with the velocity of nineteen miles a second, with which the relatively quiet "Himmelsluft" operates on the upper strata of the atmosphere which move with the earth.

Extensive investigations and measurements are still needed in order to arrive at a result in this matter, and it is only by means of the fullest co-operation of numerous observers in all parts of the world that the necessary data for this purpose will be obtained.

MILK FROM TUBERCULOUS COWS.

ACCORDING to a report by United States Consul Ryder of Copenhagen experiments have been resumed in Denmark towards elucidating the question whether milk from tubercular diseased cows, even in such cases where the udder was not affected with tuberculosis, can be the means of communicating infection. In these experiments the investigation was made in all with the milk from twenty-one diseased cows, with which forty guinea-pigs were inoculated. It had been intended that two guinea-pigs should be inoculated from each sample; but in two cases, owing to the number of these animals having fallen short, only one guinea-pig could be employed, from two to three cubic centimetres of milk being used on each occasion. The milk samples were taken by the veterinary surgeon of the cattle market, the cows being milked by him and the milk caught up into small bottles. The veterinarian selected only such cows as, on examination during life, could be classed by him as suffering in a high degree from tuberculosis; and in every case the udder and chest intestines of the animals were afterwards sent for examination, so as to obtain full assurance of the correctness of the diagnosis, as well as to ascertain the extent of development of the disease. The inoculated guinea-pigs were kept in isolated cages in such manner that only the two which had received milk from the same cow came into contact with each other. Three of the guinea-pigs were killed by rats, fortunately, however, at such distance of time (24 or 25 days) after inoculation that the inoculated tuberculosis must have shown itself had it been present. Two others died of casual (not tuberculous) lung disease after the lapse of a month and a half and two months, having no sign whatever of tuberculosis.

The results obtained from these inoculations are that milk from seventeen of the examined cows had no influence in producing tuberculosis in the guinea-pigs, while the milk from four of the cows showed itself to be communicative of infection; but in three of these cases, on examination of the udder most minutely, this could scarcely be considered in a perfectly sound state. In the one case two small tumors were found of about the size of a pea; in the two others, o the size of a hazel-nut; but in all the cases, with a sligh

hardening of the tissues in a somewhat extended circuit. When the above-mentioned tumors were cut over, they presented the exact appearance of a fresh tubercular udder inflammation, that is to say, the gland lobes were swollen, firm, and of grayish color, slighly translucent, and with yellow streaks corresponding with the lacteal passages. In dried preparations of tissue from the tumors, as well as from the infiltrated regions, tubercle bacilli could be demonstrated, and sections showed on both sides the presence of typical tuberculous tissue with giant cells containing bacilli. Thus there could be no doubt but that in all three cases a commencement of tuberculosis had to be contended with. The slighter the development of the tubercular attacks in the udder, so much the fewer will be the number of bacilli thrown off from the milk. In full agreement with this, it was found, that, of the two inoculated guinea-pigs, only one was attacked in the case where but two small tumors of a pea-size were found in the udder. The other guinea-pig was killed four weeks after the inoculation and was found to be perfectly sound. In the last of the four cases where the milk was found communicative of infection, no discernible tubercular attack was to be detected in the udder. This case, however, differed in some degree from the others. The cow in question died of tuberculosis of chronic character and in a very advanced stage, several of the organs having been attacked (the lungs, pleura, mesenteric glands, liver, and intestines), while the other cows whose milk had been examined had all been slaughtered. With these the attack had not reached the extreme stage, although in many of them it was found to be far advanced.

While this case would thus seem to prove that the tubercle bacilli can pass over to the milk without the previous existence of any tubercle tissue in the udder, it is at the same time observed that in this case there is all reason for regarding it as one of exceptional character. From the detailed report on these researches it may perhaps be gathered that the matter in question stands somewhat in the following position: If it really be the case that the milk of tuberculous cows is of such great danger as the medium of communicating infection, it might certainly be expected, looking at the great spread of tuberculosis among cattle, that the disease would, at the same time, be conveyed to human beings much more frequently than it seems, in fact, really to occur with the raw milk and (though perhaps in a somewhat less degree) with the dairy produce, especially of butter and cheese. The generally entertained opinion that milk from tuberculous cows, as a rule, only under certain conditions, was really of such dangerous character, would appear to be much more in accordance with the results obtained.

To prevent the conveyance of infection to the human being through the medium of tuberculous cows' milk, it should be the main consideration to watch for the earliest appearance of swelling or tumor of a tuberculous nature in the cow. Such recognition, as a rule, will not be of much difficulty, and at any rate will lead to good grounds of suspicion, such as a firm, painless, and, as a rule, speedily spreading glandular swelling, with the secretion in the first weeks retaining its natural appearance, but later on becoming thinner and more watery, but seldom of a pus nature. The question of danger of infection through the use of such milk is perhaps sufficiently summed up in the following words of the report on these researches, namely, that milk obtained from a tuberculous cow with an apparently sound udder, as a rule, will not be found dangerous; but, at the same time, as in no individual case can it be said with certainty that one may not be dealing with one of the depicted exceptions from the general rule, it would be advisable to regard such milk with suspicion in respect to its infecting powers.

NOTES AND NEWS.

A LONG time ago, says the *Engineering and Mining Journal*, the distinguished French astronomer Flammarion expressed the belief that communication would be established one day between the earth and the planet Mars. The idea seems to have appealed very strongly to the fancy of an old lady at Pau, France, who died recently, bequeathing a legacy of 100,000 francs as a reward to the first scientist who may devise a scheme for successfully accomplishing the feat. The money, which is payable for ten years only, is to be held in trust by the French Institute.

— Silo experience in the United States now covers more than ten years, and so far as the economy of producing silage and the advantages of feeding it are concerned, there appears to be everywhere, among those who have operated successful silos, a strong conviction that good silage is a superior and cheap feed; but the same experience is now fast demonstrating serious imperfections in the construction of perhaps a majority of existing silos in this country. Some silos have so rapidly deteriorated as to become utterly useless for the purpose for which they were intended inside of three or even two years, unless they are subjected to extensive repairs, while others have never successfully preserved the materials placed in them. With a view to obviating these difficulties in the construction of future silos, and of suggesting remedies for the defects of existing ones, a study of the actual construction and condition of silos now in use has been undertaken by F. H. King, physicist of the Wisconsin Agricultural Experiment station. Thus far he has examined ninety-three silos, and the results of his labors, together with valuable suggestions about the construction and repair of silos, are given in the July bulletin of the station named.

— Mr. O. Chanute, a well-known engineer of Chicago, having during recent visits to Europe gathered much information concerning the methods and results of preparing wood chemically to resist decay, says he is confirmed in the opinion that the time has arrived when great economies may be realized by the adoption of these methods on railroads in many parts of this country. He recently examined some experimental railroad ties of the most perishable kinds of wood, prepared by what is known as the zinc-tannin (Wellhouse) process, in St. Louis, in 1881 and 1882, and laid in the tracks of the Atchison, Topeka, & Santa Fe Railroad, as Topeka, Kan., and La Junta, Col. After nine or ten years' exposure they show excellent results, whereas they would have lasted but from one to four years if unprepared. Unprepared ties of the same kind of timber, laid at the same time, adjoining to the prepared ties, have all decayed and been taken up, while present appearances indicate that the prepared ties (red oak, black oak, and Colorado pine) are likely to show an average life of ten to fifteen years or more. Not only does the zinc-tannin process preserve ties against decay, he says, but it hardens them as well. It is found on one railroad that after three years' exposure treated hemlock ties hold the spike as well and cut less under the rail than untreated white oak. He is convinced by experience that on many railroads, where white oak is getting scarce, an economy of a hundred dollars a year per mile of track can be effected by preparing ties of inferior kinds of wood to resist decay by the process mentioned.

— The Leland Stanford Junior University of California has announced the names of the members of its faculty. The professorships in engineering and scientific studies are held as follows: John Casper Branner, formerly of the University of Indiana, professor of geology (work to begin in 1892); Oliver Peebles Jenkins, formerly of De Pauw University, professor of physiology and histology; John Henry Comstock, formerly of Cornell University, non-resident professor of entomology (resident in January, February, and March); John Mason Stillman, formerly of the University of California, professor of industrial and inorganic chem-

istry (work to begin in 1892); Ferdinand Sanford, formerly of Lake Forest University, professor of physics; Charles David Marx, formerly of the University of Wisconsin, professor of civil engineering; Joseph Swain, formerly of Indiana University, professor of mathematics; Horace Bigelow Gale, formerly of Washington University, St. Louis, professor of mechanical engineering; Charles Henry Gilbert, formerly of Indiana University, professor of vertebrate zoölogy; Douglas Houghton Campbell, formerly of Indiana University, professor of cryptogamic botany; George Mann Richardson, formerly of Lehigh University, assistant professor of inorganic chemistry; Louis Alexander Buchanan, formerly of the St. Louis Polytechnic Evening School, foreman of the wood-working shop; and Daniel Kirkwood, formerly of Indiana University, non-resident lecturer on astronomy (resident in May).

— The necessity of devoting to sleep several hours in each day, says the *Lancet*, is too obvious to admit of serious question. The proper selection of these hours is also, for those who would prolong and usefully employ life, a very needful consideration, though its importance may to some be less evident. We have all met with persons, outside of hospitals and of parliament, who do half or more of their daily work after nightfall, and sleep long after earlier rising men are awake and busy. Some of these are wont to extol the comfort of their morning slumbers. They describe as immense the refreshment they receive from six or seven hours thus agreeably spent, and no wonder, for the sense of present satisfaction must be very marked, and that for definite reasons. Man, in common with most of the animal creation, has accepted the plain suggestion of Nature that the approach of night should imply a cessation of effort. If he ignores this principle his work is done against inherited habit, and, so far, with additional fatigue. It follows, too, from our ordinary social conditions, that he must use artificial light, and sustain its combustion at the cost of his own atmosphere. Naturally, therefore, when he does rest, his relief is in proportion to his weariness. As in many other cases, however, sensation is not here the most reliable guide to judicious practice. Established custom affords a far truer indication of the method most compatible with healthy existence. The case of the overworked and the invalid lends but a deceptive color to the argument of the daylight sleeper. In them excessive waste of tissue must be made good, and sleep, always too scanty, is at any time useful for this purpose. For the healthy majority, however, the old custom of early rest and early waking is certain to prove in future, as returns of longevity and common experience alike show that it has proved in the past, most conducive to healthy and active life.

— The results of an investigation concerning the cause of the insolubility of pure metals in acids, contributed by Dr. Weeren to a recent number of the *Berichte*, are given in abstract in *Nature* of July 16. De la Rive, so long ago as the year 1830, pointed out that chemically pure zinc is almost perfectly insoluble in dilute sulphuric acid. Hitherto, however, the hypotheses put forward attempting to account for this singular fact have been any thing but satisfactory. The theory of Dr. Weeren is extremely simple, and is fully supported by the most varied experiments, physical and chemical. It may be stated as follows: "Chemically pure zinc and also many other metals in a state of purity are insoluble or only very slightly soluble in acids, because, at the moment of their introduction into the acid, they become surrounded by an atmosphere of condensed hydrogen, which under normal circumstances effectually protects the metal from further attack on the part of the acid." It is found that when a piece of pure zinc is immersed in dilute sulphuric acid, a slight action does occur during the first few succeeding moments, zinc sulphate and free hydrogen being formed in minute quantity. The free hydrogen, however, instead of escaping, becomes condensed by the molecular action of the zinc upon the surface of the latter, and is retained there with great tenacity as a thin mantle of highly compressed hydrogen gas, capable of affording perfect protection against further inroad of the acid. The experiments from which this simple and very probable explanation has been derived were briefly as follows. The amount of chemically pure zinc dissolved by the acid was first determined. It was, of course, an exceedingly minute quantity. Considering this amount as unity, it was next sought to determine what difference would be effected by performing the experiment *in vacuo*, when of course the escape of the hydrogen would be greatly facilitated. The solubility was found under these circumstances to be increased sevenfold. Next the experiment was performed at the boiling temperature of the dilute acid, first when ebullition was prevented by increasing the pressure, and secondly when ebullition was unhindered, thus again facilitating the removal of the hydrogen film. In the first case, when ebullition was prevented, the solubility was practically the same as in the cold; while in the second case, with uninterrupted ebullition, the solubility was increased twenty-four times. Finally, experiments were made to ascertain the effect of introducing into the acid a small quantity of an oxidizing agent capable of converting the hydrogen film to water. When a little chromic acid was thus introduced the solubility was increased 175 times, and when hydrogen peroxide was employed the solubility was increased three-hundred-fold. The explanation of the ease with which the metal becomes attacked when the ordinary impurities are present is that the hydrogen is not then liberated upon the surface of the zinc, but rather upon the more electro-negative impurities, leaving the pure zinc itself open to the continued attack of the acid. The same of course occurs when a plate of platinum is placed in contact with a plate of pure zinc in the acid. The action of nitric acid, the only common acid which does attack pure metals, is evidently due to the oxidation of the hydrogen film by further quantities of the acid, with formation of water and production of the lower oxides of nitrogen, and even under certain circumstances of ammonia.

— The regular quarterly meeting of the Michigan State Board of Health was held at Lansing, July 14. The most important action taken was to direct the secretary to publish a brief pamphlet telling how to restrict and prevent consumption, the pamphlet having been adopted by the board after very careful consideration. This pamphlet states that "consumption is the most common and fatal disease," "that the number of deaths which actually occur in Michigan from consumption is probably over twenty-five hundred per year," that "consumption is now known to be a communicable disease," and that "a large part of this mortality can and ought to be prevented." The pamphlet describes the bacillus which causes consumption and which is in the sputa of consumptives, cites instances where consumption has been communicated by the sputum dust containing these germs, and emphasizes the importance of destroying the sputa of consumptives. The pamphlets on the restriction and prevention of the other most dangerous communicable diseases, diphtheria and scarlet-fever, were ordered reprinted for distribution among the neighbors of those sick with those diseases throughout the State. A proposed pamphlet on the "Restriction and Prevention of Measles" was thoroughly discussed by paragraphs, amended, and the secretary was directed to print and distribute the document for instruction, and as an aid in the restriction and prevention of this disease, which the board declares is a disease "dangerous to the public health," that causes many more deaths in Michigan than small-pox does, and which should be dealt with according to the laws in Michigan.

— In the May number of the *Journal de Botanique*, says *Nature*, MM. Bureau and Franchet describe a number of new plants from the collections recently brought home by M. Bonvalot and Prince Henry of Orleans, and give a general summary of their character, of which the following is an abstract. The collection was made almost entirely in a narrow band of territory reaching from Lhassa eastward near the 30th parallel of north latitude by way of Batang and Sitang to Tatsienlow, in the province of Szechwan, in west China, from which place their route was deflected at a right angle to Yunnan. Considered in its general aspect, the flora of this region, as shown in the collection, is marked by the stunted form of the shrubs and dwarf character of the herbaceous vegetation. Of the forest trees, *Coniferæ* and others, no specimens were brought. It is characteristically a vegetation of high peaks, where drought and strong winds are the main climatic features. The

Papaveraceæ are represented especially by dwarf, large-flowered kinds of *Meconopsis*. The greater number of the species of *Corydalis* are not more than two or three inches high. The *Cruciferæ*, such as *Parrya ciliaris*, in the same way are dwarf and large-flowered. *Silene cæspitosa* may be compared with the most dwarf states of *S. acaulis* of our own high mountains. The honeysuckle of Thibet constitutes only a small bush about a foot high, with intertangled branches. But it is especially in the rhododendrons and primulas that this dwarf character is remarkable. All the rhododendrons and primulas found between Lhassa and Sitang—*R. principis*, *R. primulæflorum*, *R. nigropunctatum*, *Primula leptopoda*, *P. diantha*, and *P. Henrici*—may be ranged amongst the dwarfest types of the genera to which they belong. It is the same with *Incarvillea*. The Thibetan species belong to a group found also in Kansu and central Yunnan, with stem almost obliterated and corolla very large. Passing eastward in Szechwan the flora puts on a different character. The leaves become larger, the number of flowers to each plant increases. There are many *Rosaceæ*, orchids, and species of pedicularis; amongst the *Compositæ* the genus senecio is particularly well represented, and there are several everlastings that approach the edelweiss of the Swiss Alps. The flora of this eastern part of Thibet and western region of Szechwan has a strong affinity both with that of the Sikkim Himalaya and that of central Yunnan. *Meconopsis Henrici* represents the Himalayan *M. simplicifolia* Hook. et Thoms.; *Astragalus litargensis*, *A. acauils* Benth., *Rubus xanthocarpus*, *R. sikkimensis*; *Brachyactis chinensis*, *B. menthodora*; *Gnaphalium corymbosum* answers to *G. nubigenum*; *Androsace bisulca* to *A. microphylla*; and there are many other similar parallels between the plants of Thibet and Sikkim, and in the same many parallels may be found between the new species found by the travellers in Thibet and those gathered by Delavay in Yunnan.

— The numerous letters received at the Wisconsin Agricultural Experiment Station in relation to the chinch bug show that this pest has already done much harm to wheat and barley in some sections of that State, and that it is now moving from the grain fields into the corn fields. Any remedies tried must be quickly applied. It is now too late to introduce infected bugs, such as have been sent out by Professor Snow of Kansas. The kerosene emulsion remedy which is now being successfully used by Dr. E. Fred Russell of Poynette, Columbia County, is recommended. It is made as follows: Slice half a pound of common bar soap; put it in a kettle with one gallon of soft water and boil until dissolved; put two gallons of kerosene in a churn or stone jar, and to it add the boiling hot soap solution; churn from twenty to thirty minutes, when the whole will appear creamy. If properly made no oil will separate out when a few drops of the emulsion are placed on a piece of glass. To each gallon of the emulsion add eight gallons of water and stir. Apply with a sprinkling pot. Every farmer should learn to make this emulsion as it a most useful insecticide. It is especially valuable for killing lice on cattle and hogs. Paris green will not kill chinch bugs. If the bugs are not yet in the corn, plow a deep furrow along the side of the field they will enter and throw into it stalks of green corn. When the bugs have accumulated on the corn, sprinkle with the emulsion. Put in fresh stalks, and sprinkle whenever the bugs accumulate. If they break over the barrier, as they probably will, run a new furrow a few rows back in the corn and repeat. Where they have attacked stalks of standing corn, destroy by sprinkling. If the remedy is tried it should be used persistently. To kill one lot of bugs and then stop will do little or no good. When the bugs threaten to destroy as much as five or ten acres it will pay for one or two men to devote their whole time to the warfare. Only a part of each day, however, will be needed. Some corn will be lost at best, but the most of the field should be saved. Any one trying the remedy is requested to send the results of his experience to the experiment station.

— Professor Martens of Berlin has published in the *Mittheilungen aus den Kœniglichen technischen Versuchanstalten zu Berlin* a report (summarized in *Engineering* of July 17) of some experiments on the strength of steel at various temperatures between 20° C. and 600° C. The material used consisted of mild steel, having a tensile strength of 23 tons, 27 tons, and 30 tons per square inch. The bars from which the test pieces were cut were 1.5 inches in diameter and were thoroughly annealed. A number of bars of the same quality of metal were all tested in the usual way, both after annealing, and as received from the makers, so as to form a standard for the other bars. The temperature of the bars was made uniform by placing in a bath and testing them there. For the low temperature tests the bath was filled with a freezing mixture, and for the high temperature tests, with paraffine, up to 200° C., beyond which alloys of lead and tin were used. The contents of the bath were warmed by gas jets, and stirred during the course of the experiments. The elongations of the bar up to the yield point were taken on a length of 8.1 inches by means of a mirror apparatus, the diameter of the tested portion being 0.79 of an inch, and autographic diagrams were also taken of each specimen. The results of the experiments showed that the elastic limit of the material became lower as the temperature rose, though the falling off was not very serious up to 200° C., but beyond that point it lowers somewhat rapidly, and finally seems to disappear. The maximum stress decreases from 20° C. up to 50° C., but afterwards rapidly rises to a maximum somewhere between 200° and 250° C. Taking the strength of the specimen at 20° C., the maximum stress for the 23-ton steel is 1.34 greater, and the maximum breaking stress is 1.62. For the 27-ton steel the figures are 1.27 and 1.45, and for the 30-ton steel 1.25 and 1.50. The contraction of area for all the specimens was least at about 300° C.

— London *Engineering* announces the formation of a British syndicate, to be known as the Great Lakes Navigation Trading Company, Limited, having a capital of one million sterling with which to establish a fleet of ten steamers, each of 1,500 tons, to establish water communication between Chicago and Great Britain *via* the Great Lakes. The vessels are to be of such dimensions as will enable them to pass through the locks on the Canadian canals, and it is said that they will be ready for starting the service next spring. Keeping in mind the restless activity of Chicago, says the journal named, it is surprising that no regular service of steamers has been started between that port and Britain. There is sufficient traffic. In the Great Lakes there was carried in 1889 nearly 27,500,000 tons of cargo, the fleet of steamers consisting of 2,055 vessels, of 826,000 tons, worth nearly twelve millions sterling. The arrivals and clearances at Chicago have in ten years increased by 72 per cent to 10,250,000 tons, and it is possible to conceive of an equally large increase in the next decade, for 54,411 miles of railway terminate in that city, and in a year work 43,000,000 tons of freight. Besides, in the central northern and north-western groups of States the total tonnage of freight moved is 196,000,000 tons. A fair proportion of this comes to Europe, principally grain; and probably if through sea communication could be established and freight rates reduced, a still larger quantity might be sent. The distance from Chicago to Liverpool by the lakes and *via* New York does not differ much. By the lakes, Welland Canal, and St. Lawrence River, 4,488 miles, and *via* New York by rail, 4,353 miles; so that the latter distance can be covered in 337 hours against 346 hours in the other case. By rail to Montreal and thence by steamer the distance is 4,062 miles, requiring 328 hours. But after all, time is not a material consideration in cargo traffic. The freight rates should decide. Mr. Corthell, in a paper read recently before the Canadian Society of Civil Engineers, strongly advocates the development of this lake trade to England, by the deepening and lengthening of locks and canals, and the construction of ship railways, and he gives figures based on average rates to show that it is probable that freight could be carried by way of the lakes at half the cost of that sent by rail to New York or Montreal, and thence by steamer to Britain. If this be so, then the Chicago people, and particularly Canadians, will do well to study the matter, because to Canada, possibly more than to America, Britain may in the future have to look for grain supplies. The new syndicate wisely lay themselves out for a distinct trade. The vessels are to have extensive refrigerators. To overcome the disadvantage of the season of ice-bound rivers, which continues for rather more than a third of the year, a terminus is to be made at Portland, Maine.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

ELECTRICAL EVAPORATION.[1]

IT is well known that when a vacuum tube is furnished with internal platinum electrodes, the adjacent glass, especially near the negative pole, speedily becomes blackened, owing to the deposition of metallic platinum. The passage of the induction current greatly stimulates the motion of the residual gaseous molecules; those condensed upon and in the immediate neighborhood of the negative pole are shot away at an immense speed in almost straight lines, the speed varying with the degree of exhaustion and with the intensity of the induced current. Platinum being used for the negative pole, not only are the gaseous molecules shot away from the electrode, but the passage of the current so affects the normal molecular motions of the metal as to remove some of the molecules from the sphere of attraction of the mass, causing them to fly off with the stream of gaseous molecules proceeding from the negative pole, and to adhere to any object near it. This property was, I believe, first pointed out by Dr. Wright of Yale College, and some interesting experiments are described by him in the *American Journal of Science and Art* (Third Series, xii. 49, xiv. 169). The process has been much used for the production of small mirrors for physical apparatus.

This electrical volatilization or evaporation is very similar to ordinary evaporation by the agency of heat. Cohesion in solids varies according to physical and chemical constitution; thus every kind of solid matter requires to be raised to a certain temperature before the molecules lose their fixity of position and are rendered liquid, a result which is reached at widely different temperatures. If we consider a liquid at atmospheric pressure,— say, for instance, a basin of water in an open room,— at molecular distances the boundary surface between the liquid and the superincumbent gas will not be a plane, but turbulent like a stormy ocean. The molecules at the surface of the liquid dart to and fro, rebound from their neighbors, and fly off in every direction. Their initial velocity may be either accelerated or retarded, according to the direction of impact. The result of a collision may drive a molecule in such a direction that it remains part and parcel of the liquid; on the other hand, it may be sent upwards without any diminution of speed, and it will then be carried beyond the range of attraction of neighboring molecules, and fly off into and mingle with the superincumbent gas. If a molecule of the liquid has been driven at an angle with a velocity not sufficient to carry it beyond the range of molecular attraction of the liquid, it may still escape, since, in its excursion upwards, a gaseous molecule may strike it in the right direction, and its temporary visit may be converted into permanent residence.

The intrinsic velocity of the molecules is intensified by heat and diminished by cold. If, therefore, we raise the temperature of the water without materially increasing that of the surrounding air, the excursions of the molecules of the liquid are rendered longer and the force of impact greater, and thus the escape of molecules into the upper region of gas is increased, and we say that evaporation is augmented.

If the initial velocities of the liquid molecules can be increased by any other means than by raising the temperature, so that their escape into the gas is rendered more rapid, the result may be called "evaporation" just as well as if heat had been applied.

Hitherto I have spoken of a liquid evaporating into a gas; but the same reasoning applies equally to a solid body. But whilst a solid body like platinum requires an intense heat to enable its upper stratum of molecules to pass beyond the sphere of attraction of the neighboring molecules, experiment shows that a very moderate amount of negative electrification super-adds sufficient energy to enable the upper stratum of metallic molecules to fly beyond the attractive power of the rest of the metal.

If a gaseous medium exists above the liquid or solid, it prevents to some degree the molecules from flying off. Thus both ordinary and electrical evaporation are more rapid in a vacuum than at the ordinary atmospheric pressure.

I have recently made some experiments upon the evaporation of different subjects under the electric stress.

Evaporation of Cadmium. — A U-shaped tube was made, having a bulb in each limb. The platinum poles were at the extremities of each limb, and in each bulb was suspended from a small platinum hook a small lump of cadmium, the metal having been cast on to the wire. The wires were each weighed with and without the cadmium. The tube was exhausted, and the lower half of the tube was inclosed in a metal pot containing paraffine wax, the temperature being kept at 230° C. during the continuance of the experiment. A deposit around the negative pole took place almost immediately, and in five minutes the bulb surrounding it was opaque with deposited metal. The positive pole with its surrounding luminosity could be easily seen the whole time. In thirty minutes the experiment was stopped, and after all was cold the tube was opened and the wires weighed again. The results were as follows:—

	Positive pole.	Negative pole.
Original weight of cadmium	9.34 grains.	9.38 grains.
Weight after experiment	9.25 "	1.86 "
Cadmium volatilized in 30 minutes	0.09 "	7.52 "

Finding that cadmium volatilized so readily under the action of the induction current, a large quantity, about 350 grains, of the pure metal was sealed up in a tube, and the end of the tube containing the metal was heated to a little

[1] Abstract of a paper read by Professor William Crookes, F.R.S., before the Royal Society, London, on June 11; from Nature of July 2.

above the melting-point. The molten metal being made the negative pole, in a few hours the whole quantity had volatilized and condensed in a thick layer on the far end of the tube, near, but not touching, the positive pole.

Volatilization of Silver. — Silver was the next metal experimented upon. The apparatus was similar to that used for the cadmium experiments. Small lumps of pure silver were cast on the ends of platinum wires, and suspended to the inner ends of platinum terminals passing through the glass bulb. The platinum wires were protected by glass, so that only the silver balls were exposed. The whole apparatus was inclosed in a metal box lined with mica, and the temperature was kept as high as the glass would allow without softening. The apparatus was exhausted to a dark space of three millimetres, and the current was kept on for $1\frac{1}{2}$ hours. The weights of silver, before and after the experiment, were as follows: —

	Positive pole.	Negative pole.
Original weight of silver	18.14 grains.	24.63 grains.
Weight after the experiment	18.13 "	24.44 "
Silver volatilized in 1½ hours	0.01 "	0.19 "

In this tube it was not easy to observe the spectrum of the negative pole, owing to the rapid manner in which the deposit obscured the glass. A special tube was therefore devised, of the following character. A silver rod was attached to the platinum pole at one end of the tube, and the aluminum positive pole was at the side. The end of the tube opposite the silver pole was rounded, and the spectroscope was arranged to observe the light of the volatilizing silver "end on." In this way the deposit of silver offered no obstruction to the light, as none was deposited except on the sides of the tube surrounding the silver. At a vacuum giving a dark space of about three millimetres from the silver, a greenish-white glow was seen to surround the metal. This glow gave a very brilliant spectrum. The spark from silver poles in air was brought into the same field of view as the vacuum glow, by means of a right-angled prism attached to the spectroscope, and the two spectra were compared. The two strong green lines of silver were visible in each spectrum. The measurements taken of their wave-lengths were 3,344 and 3,675, numbers which are so close to Thalen's numbers as to leave no doubt that they are silver lines. At a pressure giving a dark space of two millimetres the spectrum was very bright, and consisted chiefly of the two green lines and the red and green hydrogen lines. The intercalation of a Leyden jar into the circuit does not materially increase the brilliancy of the lines, but it brings out the well-known air lines. At this pressure not much silver flies off from the pole. At a higher vacuum the luminosity round the silver pole gets less and the green lines vanish. At an exhaustion of about one-millionth of an atmosphere the luminosity is feeble, the silver pole has exactly the appearance of being red-hot, and the volatilization of the metal proceeds rapidly.

Like the action producing volatilization, the "red heat" is confined to the superficial layers of molecules only. The metal instantly assumes, or loses, the appearance of red heat the moment the current is turned on or off, showing that, if the appearance is really due to a rise in temperature, it does not penetrate much below the surface. The extra activity of the metallic molecules necessary to volatilize them is, in these experiments, confined to the surface only, or the whole mass would evaporate at once, as when a metallic wire is deflagrated by the discharge of a powerful Leyden jar. When this extra activity is produced by artificial heat, one of the effects is the emission of red light; so it is not unreasonable to imagine that when the extra activity is produced by electricity the emission of red light should also accompany the separation of molecules from the mass. In comparison with electricity, heat is a wasteful agent for promoting volatilization, as the whole mass must be raised to the requisite temperature to produce a surface action merely; whereas the action of electrification does not appear to penetrate much below the surface.

If, for the negative electrode, instead of a pure metal such as cadmium or silver, an alloy was used, the different components might be shot off to differen distances, and in this way make an electrical separation — a sort of fractional distillation. A negative terminal was formed of clean brass, and submitted to the electrical discharge *in vacuo*. The deposit obtained was of the color of brass throughout, and on treating the deposit chemically I could detect no separation of its component metals, copper and zinc.

A remarkable alloy of gold and aluminum, of a rich purple color, has been kindly sent me by Professor Roberts-Austen. Gold being very volatile in the vacuum tube, and aluminum almost fixed, this alloy was likely to give different results from those yielded by brass, where both constituents fly off with almost equal readiness. The Au-Al alloy had been cast in a clay tube, in the form of a rod two centimetres long and about two millimetres in diameter. It was sealed in a vacuum tube as the negative pole, an aluminum pole being at the other side. Part of the alloy, where it joined the platinum wire passing through the glass, was closely surrounded with a narrow glass tube. A clean glass plate was supported about three millimetres from the rod of alloy. After good exhaustion the induction current was passed, the alloy being kept negative. Volatilization was very slight, but at the end of half an hour a faint purple deposit was seen both on the glass plate and on the walls of the tube. On removing the rod from the apparatus it was seen that the portion which had been covered by the small glass tube retained its original purple appearance, while the part that had been exposed to electrical action had changed to the dull white color of aluminum. Examined under the microscope, the whitened surface of the Austen alloy was seen to be pitted irregularly, with no trace of crystalline appearance.

This experiment shows that, from an alloy of gold and aluminum, the gold is the first to volatilize under electrical influence, the aluminum being left behind. The purple color of the deposit on glass is probably due to finely-divided metallic gold. The first deposit from a negative pole of pure gold is pink; this changes to purple as the thickness increases. The purple then turns to green, which gets darker and darker until the metallic lustre of polished gold appears.

If we take several liquids of different boiling-points, put them under the same pressure, and apply the same amount of heat to each, the quantity passing from the liquid to the gaseous state will differ widely in each case.

It was interesting to try a parallel experiment with metals, to find their comparative volatility under the same conditions of temperature, pressure, and electrical influence. It was necessary to fix upon one metal as a standard of comparison, and for this purpose I selected gold, its electrical volatility being great, and it being easy to prepare in a pure state.

An apparatus was made that was practically a vacuum tube with four negative poles at one end and one positive pole at the other. By a revolving commutator I was able to make electrical connection with each of the four negative

poles in succession for exactly the same length of time (about six seconds); by this means the variations in the strength of the current, the experiment lasting some hours, affected each metal alike.

The exposed surface of the various metals used as negative poles was kept uniform by taking them in the form of wires that had all been drawn through the same standard hole in the drawplate, and cutting them by gauge to a uniform length; the actual size used was 0.8 of a millimeter in diameter and twenty millimetres long.

The comparison metal, gold, had to be used in each experiment; the apparatus thus enabled me to compare three different metals each time. The length of time that the current was kept on the revolving commutator in each experiment was eight hours, making two hours of electrification for each of the four negative electrodes; the pressure was such as to give a dark space of six millimetres.

The fusible metals, tin, cadmium, and lead, when put into the apparatus in the form of wires, very quickly melted. To avoid this difficulty a special form of pole was devised. Some small circular porcelain basins were made, nine millimetres in diameter; through a small hole in the bottom a short length of iron wire, 0.8 of a millimetre in diameter, was passed, projecting downwards about five millimetres; the basin was then filled to the brim with the metal to be tested, and was fitted into the apparatus exactly in the same way as the wires. The internal diameter of the basin at the brim was seven millimetres, and the negative metal filed flat was thus formed of a circular disk seven millimetres in diameter. The standard gold pole being treated in the same way, the numbers obtained for the fusible metals can be compared with gold, and take their place in the table.

The following table of the comparative volatilities was in this way obtained, taking gold as 100: —

Palladium	108.00	Platinum	44.00
Gold	100.00	Copper	40.24
Silver	82.68	Cadmium	31.99
Lead	75.04	Nickel	10.99
Tin	56.96	Iridium	10.49
Brass	51.58	Iron	5.50

In this experiment equal surfaces of each metal were exposed to the current. By dividing the numbers so obtained by the specific gravity of the metal, the following order is found: —

Palladium	9.00	Copper	2.52
Silver	7.88	Platinum	2.02
Tin	7.76	Nickel	1.29
Lead	6.61	Iron	0.71
Gold	5.18	Iridium	0.47
Cadmium	3.72		

Aluminum and magnesium appear to be practically non-volatile under these circumstances.

The order of metals in the table shows at once that the electrical volatility in the solid state does not correspond with the order of melting-points, of atomic weights, or of any other well-known constant. The experiment with some of the typical metals was repeated, and the numbers obtained did not vary materially from those given above, showing that the order is not likely to be far wrong.

It is seen in the above table that the electrical volatility of silver is high, while that of cadmium is low. In the two earlier experiments, where cadmium and silver were taken, the cadmium negative electrode in thirty minutes lost 7.52 grains, whist the silver negative electrode in $1\frac{1}{2}$ hours only lost 0.19 of a grain. This apparent discrepancy is easily explained by the fact (already noted in the case of cadmium) that the maximum evaporation effect, due to electrical disturbance, takes place when the metal is at or near the point of liquefaction. If it were possible to form a negative pole *in vacuo* of molten silver, then the quantity volatilized in a given time would be probably more than that of cadmium.

Gold having proved to be readily volatile under the electric current, an experiment was tried with a view to producing a larger quantity of the volatilized metal. A tube was made having at one end a negative pole composed of a weighed brush of fine wires of pure gold, and an aluminum pole at the other end.

The tube was exhausted and the current from the induction coil put on, making the gold brush negative. The resistance of the tube was found to increase considerably as the walls became coated with metal, so much so that, to enable the current to pass through, air had to be let in after a while, depressing the gauge one-half of a millimetre.

The weight of the brush before experiment was 35.494 grains. The induction current was kept on the tube for $14\frac{1}{2}$ hours; at the end of this time the tube was opened and the brush removed. It now weighed 32.5613 grains, showing a loss of 2.9327 grains. When heated below redness the deposited film of gold was easily removed from the walls of the tube in the form of very brilliant foil.

After having been subjected to electrical volatilization, the appearance of the residual piece of gold under the microscope, using a quarter-inch object-glass, was very like that of electrolytically deposited metal, pitted all over with minute hollows.

This experiment on the volatilization of gold having produced good coherent films of that metal, a similar experiment was tried, using a brush of platinum as a negative electrode. On referring to the table it will be seen that the electric volatility of platinum is much lower than that of gold, but it was thought that by taking longer time a sufficient quantity might be volatilized to enable it to be removed from the tube.

The vacuum tube was exhausted to such a point as to give a dark space of six millimetres, and it was found, as in the case of gold, that as a coating of metal was deposited upon the glass the resistance rapidly increased, but in a much more marked degree, the residual gas in the tube apparently becoming absorbed as the deposition proceeded. It was necessary to let a little air into the tube about every thirty minutes, to reduce the vacuum. This appears to show that the platinum was being deposited in a porous spongy form, with great power of occluding the residual gas.

Heating the tube when it had become this way non-conducting liberated sufficient gas to depress the gauge of the pump one millimetre, and to reduce the vacuum so as to give a dark space of about three millimetres. This gas was not re-absorbed on cooling, but on passing the current for ten minutes the tube again refused to conduct, owing to absorption. The tube was again heated, with another liberation of gas, but much less than before, and this time the whole was re-absorbed on cooling.

The current was kept on this tube for twenty-five hours; it was then opened, but I could not remove the deposited metal except in small pieces, as it was brittle and porous. Weighing the brush that had formed, the negative pole gave the following results: —

	Grains.
Weight of platinum before experiment	10.1940
" " after experiment	8.1570
Loss of volatilization in 25 hours	2 0370

Another experiment was made similar to that with gold and platinum, but using silver as the negative pole, the pure metal being formed into a brush of fine wires. Less gas was occluded during the progress of this experiment than in the

case of platinum. The silver behaved the same as gold, the metal deposited freely, and the vacuum was easily kept at a dark space of six millimetres by the very occasional admission of a trace of air. In twenty hours nearly three grains of silver were volatilized. The deposit of silver was detached without difficulty from the glass in the form of bright foil.

THE METEOROLOGICAL RESULTS OF THE "CHALLENGER" EXPEDITION.[1]

SEEING that water covers nearly three-fourths of the surface of the globe, and exercises an important influence on the temperature of the air above it, and, by the intervention of winds, extends that influence over the land surfaces, it was impossible to give a satisfactory account of the meteorology of the earth in the absence of records of a complete series of observations taken in the open ocean. It was, therefore, of the utmost importance that the records of the "Challenger" expedition should be thoroughly digested, and this work Dr. Buchan, after seven years' labor, brought to a conclusion rather more than a year ago. In addition to the results of the "Challenger" observations, he also made use of records of temperature, atmospheric pressure, etc., received from a large number of stations in all parts of the world. Some of the most striking points in the report are given in an address to the Royal Geographical Society, published in the Proceedings for March and accompanied by four maps, of which two show the distribution of temperature and atmospheric pressure, respectively, for the month of January, and the other two the same phenomena for July. These are reproductions of some of the fifty-two maps annexed to the report.

One important fact that the "Challenger" observations revealed is, that the daily variation of the temperature on the surface of the ocean away from land is very small, nowhere exceeding a degree between latitudes 40° north and 40° south, and falling to one-fifth of a degree in the high latitudes. The temperature of the air was found to have a range about three to four times as great as that of the water below. In the Southern Ocean, at latitude 63°, it was 0.8 of a degree, or four times as great as that of the sea in the same region. Over the open sea the humidity curve closely follows that of the temperature, falling to a minimum at four o'clock in the morning and rising to a maximum at two in the afternoon; but near land a second minimum occurs from about 10 A.M. to 2 P.M. At this time, the land being heated, a current rushes in from the sea to take the place of the hot air that rises from it, and dry air from the upper regions of the atmosphere descends over the ocean. Over the open sea the barometer, though removed from the disturbing influence of land, shows as marked oscillations as over land where the diurnal variation of temperature is great. The cause must be sought in the daily changes in the temperature and humidity of the air produced through all its height by solar and terrestrial radiation.

Another important fact is that, latitude for latitude, the amplitude of the barometric oscillations is larger in an atmosphere highly charged with aqueous vapor than in a dry one. In the anticyclonic regions of the Atlantic and Pacific, the barometer falls only about 0.025 inches from the morning maximum to the afternoon minimum. Since pressure remains high, though currents of air are constantly flowing out from these regions in all directions over the surface of the ocean, it follows that the dry air from above must descend into their centres. These anticyclonic regions play a most important part in regulating the climates of the neighboring continents. The four principal lie in the Atlantic and Pacific, at about latitudes 36° north and south, and appear in all the monthly charts, with the exception of the North Atlantic region, which is absent in the month of January only. The absolutely highest mean pressure for any month, about 30.5 inches, is to be found in central Asia in the month of January. Here, to the south of Lake Baikal, is the centre of a great anticyclone, covering a large part of Eurasia, from which south and south-west winds blow over Russia and western Siberia, raising the temperature of these countries. Their effect may be seen on the temperature chart, on which the isothermals run nearly north and south.

[1] From the Scottish Geographical Magazine for July.

Another example of the effect of pressure on climate may be taken from the low-pressure system in the North Atlantic, where the lowest mean pressure of 29.5 inches occurs between Iceland and the south of Greenland. This system gives rise in winter to south westerly winds in western Europe, and north-westerly winds over North America. While, therefore, the temperature of the former is abnormally raised by winds from lower latitudes, that of the latter is lowered by cold breezes from the Arctic regions. Hence, the temperature of the coast of Labrador is only — 13°, while on the same parallel in Mid-Atlantic it is 45°, or 58° higher.

The influence of other cyclonic and anticyclonic areas is discussed in Dr. Buchan's article. In reference to the drawing of isobars, the author gives a warning against the use of observations in steep and confined valleys, where descending cold currents at night and ascending warm currents in the afternoon unduly raise and depress the barometer alternately. Thus, in the Valley of Tönset, in Norway, the mean is 29.95 inches, while at Dovrê, situated at about the same elevation but separated from Tönset by a broad range of mountains, it is 29,87 inches.

Lastly, a few figures must be quoted regarding the velocity of the wind. This the "Challenger" observations showed to be greater over the open sea than near land, the mean difference being from four to five miles per hour. It is greatest over the Southern Ocean (23 miles per hour) and least over the North Pacific (15 miles). The curves on the open sea show a very slight diurnal variation, but near land they exhibit a distinct minimum between 2 and 4 A.M., and a maximum from noon to 4 P.M. The difference between the velocities on sea and land is greatest at 4 A.M., and gradually falls to a minimum at 2 P.M., demonstrating the effect of the land in reducing the velocity by friction, and the fact that this effect is, in some way or other, partially counteracted by the heating of the surface of the land. Such are a few of the important results pointed out in Dr. Buchan's paper, which is so full of valuable information that no abstract can do it justice.

THE NEW LAKE IN THE COLORADO DESERT.

SPEAKING of the lake recently formed in the Colorado desert, in the southern part of California, by the overflow of the Colorado River, Major J. W. Powell, director of the United States Geological Survey, recently gave a reporter of the New York *Times* some interesting facts.

"The traditions of the Indians are by no means the only evidence that this basin has heen filled, wholly or partially, before," said Major Powell. "Since the delta was formed, and that portion of the Gulf of California was cut off and left to evaporate under the terrific heat of the sun, the Colorado has been playing pranks of this sort on several occasions. Along the hills which form the sides of this basin there are shoremarks which indicate that at different times the basin has been flooded to different heights, and then, when the river cut back through its old channel, evaporatian has again changed the lake to a parched desert. Along these shore-lines shells have been found which confirm this theory. The action of the Colorado in cutting new mouths for itself and then stopping them up is comparatively rapid because of the quantity of silt which the stream carries. It is not unlikely that the supposed traditions of the Indians are facts within the memory of some of the older ones of the scattering bands that live on the hillsides along the basin, for indications are that the valley has been inundated within fifty years, and certainly it has been at least once or twice since this continent was discovered.

"There is no immediate danger of the basin being filled, because it requires a large volume of water to fill it to the river level, and the evaporation is something wonderful. At the present time, according to reports, only a fraction of the water in the Colorado is flowing through this new outlet. It is possible that the channel may be enlarged as the stream continues to flow through it, so that all the water in the river will pour into the basin. Even if that were to happen the evaporation is great

enough to take up fully one-half of the Colorado as it spreads over the basin, and it would probably require from two to three years for the balance to fill the hole up to level. At such times as the river filled the basin to its level the flow to the Gulf of California has been through a channel which begins at the lower end of the basin, and makes a short cut directly south to the salt water. This is called Hardy's Colorado, and it is usually simply a dry channel or ditch. It may have been formed under circumstances similar to those existing at present. It is large enough to accommodate the entire volume of the Colorado after the evaporation which is sure to take place while the water is spread over the basin.

"Some idea of the terrible heat may be had from the evaporation which takes place. If the basin were filled to the river level, the lake would present a surface of about 1,600 square miles. This would be lowered at the rate of six feet a year by evaporation. The salt which is now being mined at Salton was deposited in the valley by the previous evaporations. The original salt deposit from the water which was a part of the Gulf of California is not responsible for all that is found there. The waters of the Colorado are saline, for the river flows through beds of rock salt at places many miles up from its mouth, and the successive deposits from the waters of this river as they have flooded the valley and then dried up have added largely to the original deposit."

OXFORD SUMMER MEETING OF UNIVERSITY EXTENSION STUDENTS.[1]

THE process by which university extension is carried throughout the country and made a vehicle for the further education of the adult student is well known, and is gradually becoming more and more appreciated in proportion as those who are responsible for the method improve the lines on which it is carried out. The machinery employed embraces lectures, classes, travelling libraries, etc., but one element vitally necessary to the university student is not supplied by these aids. This element is that of residence, and it was a happy suggestion on the part of the originators to propose that, for one month in the long vacation, arrangements should be made by which those who have profited by being brought into contact with a university lecture should enjoy the additional advantage of being brought under the charm that haunts the colleges and cloisters of Oxford and Cambridge.

The Oxford summer meeting commences on July 31, and is continued throughout the month of August; but, for the benefit of students who are unable to be present during so long a period, the course is divided into two sections, the second commencing on August 12. It has been found desirable to remove as far as possible the fragmentary and isolated character of the lectures given at these meetings, and therefore, while the course will be complete and independent in itself, it will also form the first part of a cycle of study which for its full development will embrace a period of four summers.

That these lectures propose something more than to add piquancy to an agreeable picnic will be shown from the following slight sketch of the subjects treated — and treated by authorities of acknowledged reputation. To take the lectures on natural science first: in physiology, Mr. Poulton will discuss the recent criticisms of Weismann's theory of heredity, and Mr. Gotch will lecture on the functions of the heart. In chemistry, Professor Odling lectures on the benzine ring, and under the supervision of Mr. Marsh a course of practical chemistry will be conducted in the laboratory of the University Museum. In geology, a course of practical instruction will be given by Professor Green and Mr. Badger, to include excursions in the neighborhood of Oxford. A class in practical astronomy will be welcomed at the university observatory; while electricity finds an able exponent in Mr. G. J. Burch. But the distinguishing feature of this meeting is the attention given to agricultural science "designed for agricultural audiences under county council schemes." This designation seems somewhat vague, and it will be very interesting to see the character of the audience attracted by this title. Four lectures are offered: the first entitled, "The Application of Science to the Art of Agriculture." This description is sufficiently wide, but does not indicate whether the lecture is intended as a sample of those which state-aided board schools in agricultural districts might well offer to lads who have passed through the successive standards, or as one addressed to the sons of farmers, and supplying that form of instruction which it is the duty of agricultural colleges to impart. Another lecture is offered on the management of poultry. This is more definite and more hopeful; and when we remember that the students who come up for these summer meetings are, for the most part, ladies, who can well be supposed to take an intelligent interest in this part of farming operations, we must admit that the subject is well chosen. Manures of various characters form the subject of the other two lectures, and will be doubtless of a sufficiently technical character.

The literature and history lectures are of special interest, and by the combination of many lecturers are made to cover with great completeness the mediæval period. Mr. Frederic Harrison gives, as an inaugural lecture, a survey of the thirteenth century, and strikes the keynote of this section; while in the entire course, which embraces some sixty lectures, we meet the names of Professor Dicey, of Mr. York Powell, of Mr. Boas, and a host of others, affording alike a sufficient guarantee for the excellence of the work, and a happy augury for the success of the meeting.

[1] Nature, July 16.

THE FORESTS OF ZULULAND.

AN interesting and valuable report on the forests of Zululand, by Colonel Cardew, has been issued by the British Colonial Office as an official paper. Colonel Cardew's report, an abstract of which we find in the Proceedings of the Royal Geographical Society for July, deals in the first place with the existing state of the forests of Zululand, then with the measures necessary to preserve them, and lastly with the establishment of a staff necessary for the enforcement of the laws and regulations required to effect the better preservation of these forests. As to their general distribution, the forests of Zululand, Colonel Cardew says, may be conveniently divided in the same manner as has been done by Mr. Fourcade, assistant conservator of forests, in his report on the Natal forests; that is to say, into high timber forests, thorn bush, and coast forests. The high timber forests are situated on the Nkandhla and Qudeni ranges of mountains in the Nkandhla district; on the Entumeni and Eshowe Hills and the Ungoye Mountains, in the Eshowe district; on the slopes of the Ceza, and on the Useme, Empembeni, Makowe, and other hills in the Ndwandwe district; and on the VBombo Mountains, in the district of that name. The thorn bush is to be found to a greater or less extent in all the river valleys of Zululand, the timber increasing in size and the bush in density on the lower parts of the rivers, especially in those of the Umkusi, and White and Black Umfolosi. It is very large and dense in the country west of St. Lucia Lake.

The coast forests are of no great extent, with the exception of the Dukuduku; they grow in small patches along the streams and rivers near the coast, and especially at their mouths, and also cover the low sand-hills which border the coasts of Zululand. The Dukuduku is situated on the north side of the lower Umfolosi River in the district of that name. It is several miles in extent and very dense, and was the place of retreat of the coast chiefs during the disturbances of 1888. Dealing more particularly with the distribution of the high timber forests, Colonel Cordew states that the Qudeni forests clothe the slopes and spurs of the Qudeni Mountain, a magnificent range rising to an altitude of some 4,500 to 5,000 feet, and situated between the Tugela and Insuzi Rivers. The forests are of great extent. In the absence of a survey it is impossible to say what area they cover, but they clothe the southern, eastern, and northern slopes of the mountain, and from their extent and vastness are most imposing in appearance. They are certainly the finest forests in Zululand, and are composed of the most valuable timber, of the same nature and variety as that of the high timber forests of Natal. Yellow wood, both onteniqua and upright, abounds, and there is also every description of hard wood, but from want of adequate protection these noble forests have in many parts been ruthlessly destroyed. Woodcutters do

their work in the most reckless and wasteful fashion, and are subject to no sort of efficient control.

The district of Nkandhla comprises the long range of mountainous country which forms the watershed between the Umhlatuze and Insuzi rivers. The highest ridge, which attains an altitude of at least 4,500 feet, is called Nomance. The Nkandhla forests are of great extent, and are situated chiefly on the southern slopes of the Nkandhla range. One belt of forest, called the Dukuza, is several miles in length, and takes two hours to traverse on horseback. Many are of opinion that these forests are finer than those of the Qudeni. They have not suffered at all from the spoilers in the shape of sawyers, but licensed pole-cutting has been going on to some extent on the Nomance ridge. This pole-cutting is very destructive to forests unless the work is carefully supervised by a forest department, and the poles to be cut selected with a view to proper cultural treatment, which has not been the case.

The Entumeni forests are situated on the highlands, which rise to an altitude of 2,800 feet, between the Mhlatuzi and Matikulu rivers. The timber in these forests is inferior to that of the Qudeni and Nkandhla. The Eshowe forests are not very extensive; they grow in patches on sheltered kloofs and hollows, and along water-courses and streams, filling up the valleys. They are most abundant on the eastern and southern slopes of the Eshowe range. They furnish no hard woods of any value.

Next to the Qudeni and Nkandhla, the Ingoye forest is the finest in Zululand. It is situated along and on the southern slopes of the Ingoye range, which forms the watershed between the Mhlatuzana and Mlalazi rivers. It grows at an altitude of from 1,000 to 1,500 feet, and is of great length, extending from ten to twelve miles. It is a virgin forest in the sense that it has never been cut into by sawyers, but the work of denudation by the natives is very apparent, more so than elsewhere. It is evident from the stumps of trees left, and from patches of wood here and there, that the lower slopes of the Ingoye range were formerly clothed with forests to its base, but gradually by the process of cultivation and wattle-cutting the forest line is receding up the mountain. Other patches of forest land are scattered here and there throughout Zululand, but these are the most important forests which call most urgently for some regulation, lest by the joint action of whites and natives they should be to a great extent deteriorated or even destroyed.

BOOK-REVIEWS.

Education and Heredity. By J. M. GUYAN. Tr. by W. J. Greenstreet. (Contemporary Science Series.) New York, Scribner. 12°. $1.25.

THE title of this book is misleading, there being nothing in it about the relations of education to hereditary tendencies except a brief passage at the end of the second chapter. A large part of the book is devoted to a presentation of the author's peculiar theory of the origin of the moral sentiments, a theory which he evidently deemed of great value, but which seems to us about as worthless as a psychological theory well can be. M. Guyan affirms that the mere power of doing right leads us to do right, or, as he expresses it, "to be inwardly aware that one is capable of doing something greater is *ipso facto* to have the dawning consciousness that it is one's *duty* to do it" (p. 72). Evidently M. Guyan was not much gifted with the philosophical faculty. When, however, he leaves these discussions about the origin of the moral faculty and turns to his proper subject of education, he says many things that are wise and suggestive, though nothing that is really original.

His first point is the importance of moral education, on which he dwells at considerable length, maintaining, in opposition to Ribot and others, that precept and example have a powerful influence on the moral nature, modifying in a marked degree the inborn tendencies of the individual. Physical education, too, is dwelt upon at considerable length, the author fearing the effect of over-study upon the young and especially upon girls. When he comes to treat of intellectual education he takes somewhat different ground from what his scientific proclivities would lead us to expect, putting science in a secondary place, and assigning the first to the humanities. "We ought," he says, "to place esthetic before intellectual and scientific instruction, because the beautiful lies nearest to the good, and esthetics, art, literature, and what have been so well called the humanities, are the least indirect influences making for morality" (p. 161). The book as a whole, barring the author's strange theory of the moral sense, is a good one, and will doubtless be interesting to educators.

AMONG THE PUBLISHERS.

THE *Illustrated American* for Aug. 1 contains a good portrait of the late Edward Burgess.

—Charles L. Webster & Co. have now ready Mrs. Alexander Ireland's "Life of Jane Welsh Carlyle."

—G. P. Putnam's Sons have just ready in the Story of the Nations series "The Story of Portugal," by H. Morse Stevens.

—The Seegur & Guernsey Co., 7 Bowling Green, New York, will publish at once the "Cyclopædia of the Manufactures and Products of the United States" in a revised and enlarged form.

—In *Outing* for August is an article on "Photographing in the White Mountains," by Ellerslie Wallace, and one on the "Theory and Introduction of Curve Pitching," by O. P. Caylor.

—Howard Lockwood & Co. have just issued Part 2 of their "American Dictionary of Printing and Bookmaking" It extends from Blatt to Chinese Printing, and is, like its predecessor, freely illustrated with technical cuts and with portraits.

—In its August number the *New England Magazine* publishes the "Harvard Commencement Essays." The topics are, "The Harvard Senior," by Henry R. Gledhill; "Edward Rowland Sill," by Charles W. Willard; and "A Remedy for American Philistinism," by Charles Lewis Slattery.

—The August *Babyhood* contains an article on hay-fever by Dr. Samuel Ashhurst, who lays great stress on the importance of counteracting the tendency towards hay-fever in childhood. "Science for Children," in the same number, is an article that contains information as to how to make out-door life at the present season profitable to both mother and child.

—In the *Atlantic Monthly* for August, Olive Thorne Miller, in "Two Little Drummers," treats the yellow-bellied woodpecker (sometimes called the sap-sucker) and the red-headed woodpecker; and Agnes Repplier contributes a paper on "The Oppression of Notes," which will touch a responsive chord in readers who have struggled with foot-notes far too copious and obtrusive.

—"The Press as a News Gatherer" is the subject of a paper by William Henry Smith, manager of the Associated Press, in the August *Century*, and is the first of several separate papers on journalism which are to appear in that periodical. Mr. Smith traces the origin and growth of the Associated Press, and discusses topics of special interest to newspaper editors, as well as to the public.

—John Wiley & Sons are engaged upon the work of getting out Thurston's "Manual of the Steam Engine." The first volume is printed, and will soon appear; the second is in press. The work makes two volumes of about 850 pages each, and is intended for use by engineers generally, as well as by students in the graduated courses directed by its author in Sibley College at Cornell University, and for other technical schools giving attention to such advanced work. Part I. is devoted to the development, structure, and theory of the engine; Part II. to the design, construction, and operation, and to the finance of its application. Part II. also includes a chapter on engine-trials, with special attention to experimental research and the scientific study of the engine. Messrs. Baudry & Cie of Paris have applied for and received the contract for publication of a translation into French, to be issued next year. They have already in hand, and well advanced, a translation of Thurston's "Engine and Boiler Trials," published in America and Great Britain by the Wileys, and which has already passed to a second edition. It is anticipated that the

"Manual" will find a very large sale both in the United States and Europe.

— An American edition of the Rev. J. B. Lock's "Arithmetic for Schools," edited and arranged by Charlotte A. Scott of Bryn Mawr College, has been issued by Macmillan & Co. In this work Mr. Lock has aimed to avoid novelty in method or in arrangement, though it differs in some respects from other works on the same subject. Rules, for instance, are to a great extent entirely omitted, specimen examples fully worked out being given instead, the theory, concisely stated, being set forth in large type, and the illustrations and explanations in smaller type. The examples are numerous and well graded.

— The August *Magazine of American History* is a rich midsummer number. It opens with the first part of an article on "The Spartans of Paris," by General Meredith Read, illustrated with portraits of literary celebrities of France. A picture of the editor and author, M. Arsène Houssaye, forms the frontispiece to the number. "The Fifteenth State," by John L. Heaton, gives information in relation to the settlement of Kentucky, showing how the mountain barriers were passed, and that a race-course was established in 1775, so early that one man was shot by Indians while speeding his horse upon it. "The Beginnings of the City of St. Joseph," by Judge William A. Wood, is an account of the founding of that city less than half a century ago. It contains an amusing picture of the first post-office there, in 1841, which was an old hat. The fourth paper of the number, entitled "The Right Reverend Samuel Provoost, first Bishop of New York," by Rev. Isaac S. Hartley, is a study, not only of the varied work of the subject, but of the exciting times in which he lived. "A Character Sketch of Mr. Gladstone," by Hon. J. L. M. Curry, will attract every reader. A paper follows on "Governor Meriwether Lewis," the explorer of the western part of the continent, contributed by General Marcus J. Wright of Washington. Other articles include "The Bewitched Children of Salem, 1692," by Caroline E. Upham; "The Royal Couple of Roumania;" "Archæology in Missouri," by O. W. Collett; and "The Four New York or Senior Regiments of Troops in 1775."

— "Lessons in Astronomy," by Professor Charles A. Young (Boston, Ginn & Co.), has been prepared to meet the wants of certain classes of schools which find the same author's "Elements in Astronomy" too extended and mathematical to suit their course and pupils. It is based upon the last-named work, but with many condensations, simplifications, and changes of arrangement. One of the principal changes is the placing of the uranography, or "constellation-tracing," in the body of the text, near the beginning, and supplementing it with brief notes on the mythology of the constellations.

— Ginn & Co. have in press the first volume of Bacon's "Advancement of Learning," edited by Prof. A. S. Cook of Yale. In this edition the quotations from the ancient tongues are all rele-

gated to the foot of the page, and their place in the text is supplied by as adequate a translation as possible. In this way the needs of the average student and those of the person of special erudition are both provided for; the former experiences no interruption, and the latter may read the exact words which Bacon wrote. The same principle is adopted in the notes. Many of the latter are not original with the present editor, but they are such as any one who understands English may read.

— The American Book Company have just issued "Elements of Civil Government," by Alexander L. Peterman. It is a small book, intended for the use of schools, and as it attempts to deal with the whole subject of American government, federal, State, and municipal, the treatment is necessarily brief and somewhat superficial. The descriptive portions, however, are quite good, and the work is not encumbered, as so many such books are, with a mass of irrelevant historical matter. It opens with an account of government in the family and in the school, which can hardly be called civil government, and then proceeds to treat successively of the town, county, city, and State, and of the United States. To our mind this is a wrong method of procedure, the State being the foundation of civil order, and therefore requiring to be treated first; while the towns and counties, being mere agents of the State, should be passed over with slight notice. Mr. Peterman fails, too, as most writers of such treatises do, to give a clear idea of what government is for, and why we are bound to obey it. The work is faulty also in reviving the old fiction of a social contract as the basis of civil society; and in general the theoretical parts of the book are inferior to the descriptive. It will serve, however as an introduction to the subject, which can afterwards be pursued in more philosophical treatises.

— D. C. Jackson, electrical engineer in charge of the central district of the Edison General Electric Company, with headquarters at Chicago, has accepted the chair of electrical engineering in the University of Wisconsin.